

WHAT IS CLAIMED IS:

- 1 1. A process for treating organosilicate dielectric material, comprising:
2 exposing the material to a halogenation reagent;
3 exposing the material to an alkylation reagent; and
4 exposing the material to a termination reagent.
- 1 2. The process of claim 1 wherein the halogenation reagent is selected from the group
2 consisting of SOCl_2 , SOBr_2 , PCl_3 , PBr_3 , PCl_5 , PBr_5 , POCl_3 , Cl_3 , and Br_2 .
- 1 3. The process of claim 1 wherein the alkylation reagent is selected from the group
2 consisting of ethylene, propylene, 1-butylene, and Grignard reagents.
- 1 4. The process of claim 1 wherein the termination reagent is selected from the group
2 consisting of trimethylchlorosilane, hexamethyldisilazane, and alkyl halides.
- 1 5. The process of claim 1 wherein the process occurs *in situ* with a process that breaks at
2 least one silicon-carbon bond in the dielectric material.
- 1 6. The process of claim 1 further comprising using an energy generator to increase the
2 reaction rate of the process.

1 7. A process for fabricating an insulating layer on an integrated circuit structure comprising:
2 forming a layer of organosilicate insulating dielectric material on the integrated circuit
3 structure;
4 forming a resist mask on the layer of dielectric material;
5 etching the layer of dielectric material using the mask;
6 removing the resist mask;
7 exposing the dielectric material to a halogenation reagent;
8 exposing the dielectric material to an alkylation reagent; and
9 exposing the dielectric material to a termination reagent.

1 8. The process of claim 7 wherein the halogenation reagent is selected from the group
2 consisting of SOCl_2 , SOBr_2 , PCl_3 , PBr_3 , PCl_5 , PBr_5 , POCl_3 , Cl_3 , and Br_2 .

1 9. The process of claim 7 wherein the alkylation reagent is selected from the group
2 consisting of ethylene, propylene, 1-butylene, and Grignard reagents.

1 10. The process of claim 7 wherein the termination reagent is selected from the group
2 consisting of trimethylchlorosilane, hexamethyldisilazane, and alkyl halides.

1 11. The process of claim 7 wherein the removal of the photoresist mask and the exposure to
2 the reagents are performed in a common chamber.

1 12. The process of claim 11 further comprising using an energy generator in the chamber to
2 increase the reaction rate of the process.

- 1 13. A semiconductor device, comprising a methylsilsesquioxane dielectric where at least one
2 of the methyl groups has been replaced by end groups of the form R_1OR_2 , wherein R_1 is selected
3 from the group consisting of C_1 - C_5 lower alkyls and R_2 is selected from the group consisting of
4 trimethylsilyl and C_1 - C_5 lower alkyls.
- 1 14. A process for treating damaged low-k organosilicate dielectric material whose dielectric
2 properties have been degraded by a previous processing step, comprising:
3 exposing the material to a halogenation reagent;
4 exposing the material to an alkylation reagent; and
5 exposing the material to a termination reagent.